

Claims

[c1] 1.A process for generating a 3-dimensional (3D) object copy with 2-dimensional (2D) details comprising:

- capturing 3D details of a 3D subject;
- loading the 3D details into a geometry file;
- capturing a 2D image of the 3D subject to generate a 2D image file;
- transferring the 2D image file to an image-processing computer;
- generating a printer file from the 2D image file and sending the printer file to a printer;
- transferring a 2D image represented by the printer file onto a plastic sheet to generate a printed 2D image sheet;
- transferring the geometry file to a 3D milling machine;
- inserting a milling blank into the 3D milling machine;
- cutting the milling blank on the 3D milling machine according to the 3D details from the geometry file to generate a custom milled shape;
- placing the custom milled shape as a mold on a vacuum forming machine; and
- aligning, heating, and vacuum-forming the printed 2D image sheet using the custom milled shape to re-form

the printed 2D image sheet to contours of the custom milled shape to form the 3D object copy having 2D detail from the printed 2D image sheet after molding, whereby the 3D object copy has 2D details from the 2D image file but a shape described by the geometry file.

- [c2] 2.A product produced by the process of claim 1, wherein the product is the 3D object copy that comprises the printed 2D image sheet after molding and separated from the custom milled shape or the 3D object copy comprises the printed 2D image sheet after molding and attached to the custom milled shape.
- [c3] 3.The process of claim 1 further comprising:
separating the printed 2D image sheet from the custom milled shape after molding by the vacuum forming machine;
whereby the printed 2D image sheet is molded into a 3D shape by the custom milled shape.
- [c4] 4.The process of claim 3 wherein the printed 2D image sheet is an image of a person's face;
wherein the custom milled shape is a 3D face or a person's head.
- [c5] 5.The process of claim 1 wherein the printer is a color printer but the custom milled shape is mono-color;

whereby color details are added to the 3D object copy by the printed 2D image sheet and shape details are formed from the custom milled shape.

- [c6] 6.The process of claim 5 wherein capturing 3D details of the 3D subject and capturing the 2D image of the 3D subject to generate the 2D image file comprise image capture and 3D-detail capture by a 3D camera, whereby the 3D camera generates both the geometry file and the 2D image file.
- [c7] 7.The process of claim 6 wherein capturing 3D details of the 3D subject with the 3D camera and capturing the 2D image of the 3D subject comprise using a single lens of the 3D camera to capture both the 2D image and the 3D details, whereby 3D and 2D information is captured through a same lens.
- [c8] 8.The process of claim 1 wherein the image-processing computer is a personal computer, a laptop computer, or a workstation.
- [c9] 9.The process of claim 8 further comprising: editing the 2D image file using photo-editing software on the personal computer, the laptop computer, or the workstation.

- [c10] 10.The process of claim 8 further comprising:
removing an image of human nostrils from the 2D image
file by covering the image of human nostrils with a skin
color from the 2D image file.
- [c11] 11.The process of claim 1 wherein transferring the ge-
ometry file to a 3D milling machine comprises first
transferring the geometry file to a pre-processing com-
puter that generates a machine-instruction file from the
geometry file, then sending the machine-instruction file
to the 3D milling machine,
whereby the geometry file is pre-processed for the 3D
milling machine.
- [c12] 12.The process of claim 1 wherein the plastic sheet is a
heat-formable plastic sheet.
- [c13] 13.The process of claim 12 wherein the plastic sheet is
styrene, polyethylene, butyrate, glycol-modified
polyethylene terephthalate (PETG), or other heat-
formable sheet.
- [c14] 14.The process of claim 12 wherein the plastic sheet is
pre-coated to improve ink absorption from the printer.
- [c15] 15.The process of claim 1 wherein transferring the 2D
image onto the plastic sheet comprises directly printing

the 2D image onto the plastic sheet that is a pre-coated ink-absorption plastic sheet.

- [c16] 16. The process of claim 1 wherein transferring the 2D image onto the plastic sheet comprises directly printing the 2D image onto a decal sheet to generate a printed decal and transferring the printed decal to the plastic sheet to generate the printed 2D image sheet.
- [c17] 17. The process of claim 1 wherein the custom milled shape is a male or a female molded shape.
- [c18] 18. The process of claim 17 wherein the custom milled shape is an initial shape that is re-molded with other materials to form a final custom milled shape before vacuum forming.
- [c19] 19. The process of claim 1 wherein aligning, heating, and vacuum-forming the printed 2D image sheet comprises heating a portion of the printed 2D image sheet.
- [c20] 20. The process of claim 1 wherein aligning, heating, and vacuum-forming the printed 2D image sheet comprises heating the printed 2D image sheet before or after alignment.
- [c21] 21. A generated three-dimensional 3D object with a formed color-detail sheet comprising:

a custom milled shape having been made by milling in three dimensions a milling blank according to 3D details from a geometry file captured by a 3D camera of a subject; and

a molded printed 2D image sheet, molded and affixed to a contoured surface of the custom milled shape, the molded printed 2D image sheet being molded to fit contours of the custom milled shape by molding a flat printed 2D image sheet that has a 2D image of the subject printed thereon,

whereby the generated 3D object is generated from the 3D details of the subject from the geometry file and from the 2D image of the subject printed on the molded printed 2D image sheet.

[c22] 22. The generated 3D object of claim 21 wherein the 2D image is also captured by the 3D camera that captures the geometry file.

[c23] 23. The generated 3D object of claim 21 wherein the custom milled shape is mono-color while the 2D image printed on the molded printed 2D image sheet is multi-color.

[c24] 24. The generated 3D object of claim 23 wherein the custom milled shape comprises at least two separately-milled portions and two molded printed 2D image sheets

that are joined together to produce the generated 3D object.

- [c25] 25.The generated 3D object of claim 21 wherein the custom milled shape is milled by a milling machine that is computer-controlled to cut the milling blank according to the 3D details from the geometry file.
- [c26] 26.A method comprising:
 - capturing 3-dimensional (3D) details of a 3D subject, the 3D details being mono-color;
 - loading the 3D details into a geometry file;
 - capturing a 2D image of the 3D subject to generate a 2D image file, the 2D image file being multi-color;
 - transferring the 2D image file to an image-processing computer;
 - printing a 2D image represented by the 2D image file onto a plastic sheet to generate a printed 2D image sheet;
 - transferring the geometry file to a 3D milling machine;
 - inserting a milling blank into the 3D milling machine;
 - cutting the milling blank on the 3D milling machine according to the 3D details from the geometry file to generate a custom milled shape;
 - placing the custom milled shape as a mold on a vacuum forming machine;
 - aligning the printed 2D image sheet over the custom

milled shape in the vacuum forming machine; and molding the printed 2D image sheet in the vacuum forming machine by heating the printed 2D image sheet and pulling a vacuum through the custom milled shape to re-form the printed 2D image sheet to contours of the custom milled shape to form a 3D object copy of the 3D subject, the 3D object copy having 2D detail from the printed 2D image sheet after molding, whereby the 3D object copy has 2D details from the 2D image file but a shape described by the geometry file.

- [c27] 27. A product made by the method of claim 26, wherein the product is a 3D object copy that comprises the printed 2D image sheet after molding and separated from the custom milled shape or the 3D object copy comprises the printed 2D image sheet after molding and attached to the custom milled shape.